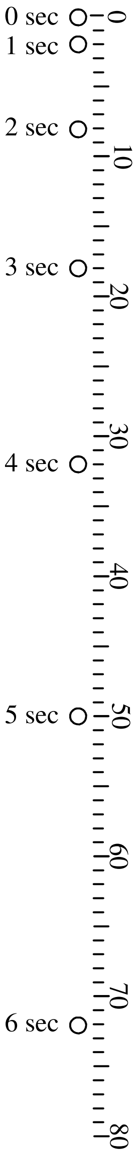
Due Tues., Sept 11

2012 PreAP Linear Motion 9



1. At the left you see the first six positions of an object moving to the right (as viewed from the left side of the page). The circles show the object's position each second. Assume the object starts at rest.

t	x (m)	v (m/s)
0		
1		
2		
3		
4		
5		
6		

A. * Calculate the average velocity between 1 and 2 seconds.

B. Calculate the average velocity between 5 and 6 seconds.

Obviously, the object is accelerating. So, let's learn a bit more about acceleration.

C. In the data table fill in the object's position for the first 6 seconds (not the velocities).

D. Where is the object after one second?

E. Where is the object after four seconds?

Notice that you can't just multiply the first position by 4. Why? Because the object is accelerating. So, it would be helpful to have the object's acceleration.

F. * You have its position after 4 seconds. Use a kinematic equation to calculate its acceleration.
Assign Variables: **Choose Equation**:
Solve:

Remember that acceleration has the units of m/s^2 OR m/s/s or m/s per sec, which means how many m/s of velocity it gains each second.

G. * What is its velocity after 1 second?

H. * What is its velocity after 2 seconds?

On the chart, fill in the object's velocities.

I. So, after 1 second the object is moving 4 m/s, meaning it could move _____ in one second.

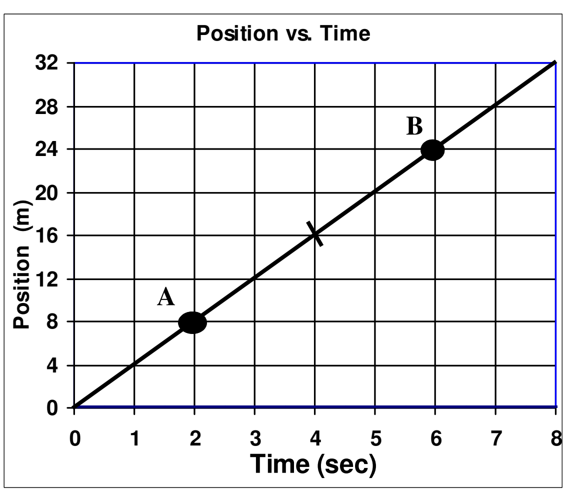
J. After 4 seconds it is moving 16 m/s, meaning it could move ______ in one second.
And yet this is not entirely true, either, because the object speeds up during each second.

K. Also notice that in one second the object has moved _____ m. After two seconds the object has moved ____ m, which is ____ times as far. In four seconds the object has moved _____ m, which is ____ times as far as in two seconds. *This pattern always holds true: in the 2nd half of any amount of time, an accelerated object travels three times as far as in the 1st half of the time OR a total of four times as far. Why? Because in the equation $\Delta x = v_i t + \frac{1}{2}at^2$, t is squared. If $v_i = 0$, doubling t quadruples Δx.*

L. Use a kinematic equation (or the above relationship) to calculate the object's position after 8 seconds.

Remember you HAVE TO use a kinematic equation when there is an acceleration. ALWAYS!

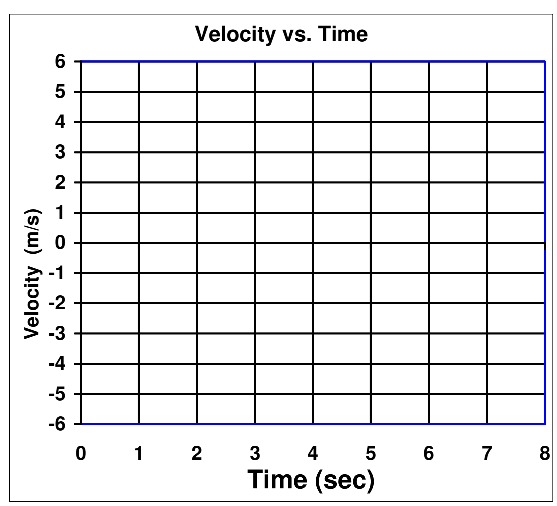
2. Let's once again transfer the position vs time graph at the left to the velocity vs. time graph on the right.

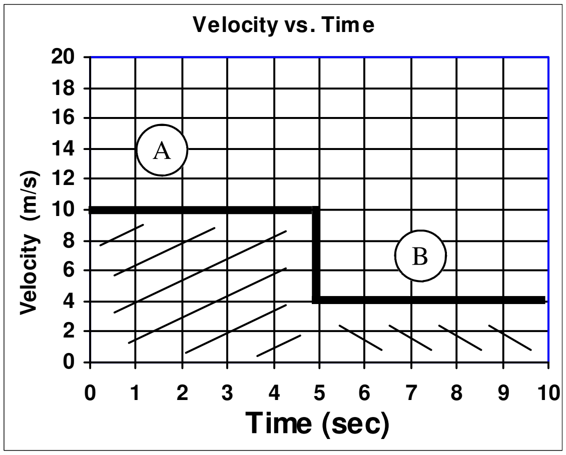


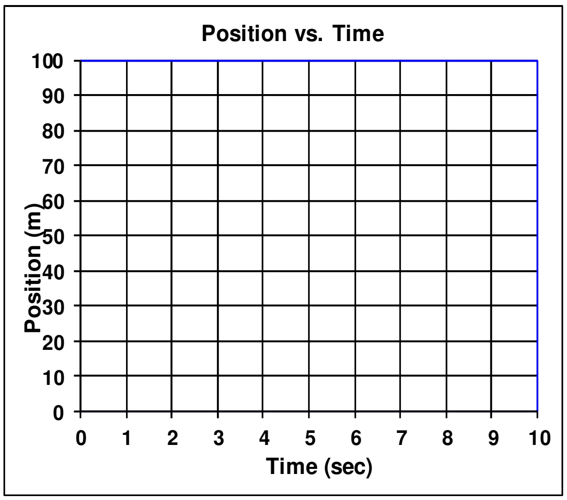
A. Using $m = \Delta y/\Delta x$, calculate the slope of segment A:

B. Find the slope of segment B:

C. Put these speeds on the velocity graph and connect them with a thick line.







3. Let's learn about transferring graphs backwards.

   A. For segment A, calculate how far the object must have travelled in the first 5 seconds. (*You have speed.*)

   B. Calculate the area of the shaded rectangle under line (L×W)

   Hmmmm. So, area = displacement.

   C. * Find the displacement of the object during line segment B's time (*you now have 2 ways*).

   You just calculated the displacement (distance travelled), but you have no information as for where it started (5m to 10m is the same displacement as 20 m to 25 m). So let's make our lives easier and assume it started at 0m.

   D. Transfer the information you just calculated to the position graph, starting at the origin.

1B) Use $\Delta x = v_i t + ½at^2$. And only the t is squared. 1C) 42.2 m/s^2 (wow!)

1G) 4 m/s 1H) 8 m/s which is 4m/s times 2 seconds. (gains 4 m/s every second)

2A) 10mi/1hr = 10 mph. If speed stays constant, his instantaneous speed (what he sees on his speedometer stays at 10 mph.

2D) he returned home, so displacement is 0.

3C) 4m/s for 5 sec = 20 m

